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Incentives to Innovate: Profit Sharing and Employee Health and Safety

Master’s Thesis
Minna Lehtinen
Aalto University School of Business
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Aalto University
School of Business

Aalto University, P.O. BOX 11000, 00076 AALTO
www.aalto.fi

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Author Minna Lehtinen

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Abstract

Corporate innovation has long been established as a key strategic factor to ensure economic growth and competitive advantage of firms. This novel study contributes to the underexamined fields of non-executive and non-monetary incentives to innovate. I empirically study the effect of profit sharing programs that are targeted to the majority of a firm's employees on corporate innovation. In addition, I test how health and safety concerns in a firm impact its innovativeness. In my data, profit sharing program occurs in a firm when there is a clear link between the profit of the company and the employee compensation in a given period. Health and safety concerns covered in the dataset are, for instance, workplace accidents, injuries, and fatalities.

My final sample consists of 2,686 firm-years and involves U.S. firms jointly covered in the NBER Patent and Citation Database, MSCI ESG KLD STATS database and Compustat between 1995 and 2003. I assess the use of profit sharing and the occurrence of health and safety concerns with dummy variables. To measure corporate innovation, I follow earlier literature and use the numbers of patents, patent citations, and them scaled with R&D expenses. In addition, I include several control variables, including firm size, executive compensation and capital expenditures. As methodology, I use standard OLS regressions and negative binomial regressions.

This study shows support to the importance of non-executive and non-monetary innovation incentives. I find a positive and significant effect of profit sharing programs, and a negative and significant effect of health and safety concerns, on all the aforementioned innovation measures. However, I do not find significant results when running additional regressions with R&D expenses scaled by assets as innovation measure.

Furthermore, I find that the impacts of profit sharing and health and safety concerns on innovation are more pronounced in those firms, where the input of non-executive employees is stronger. However, I do not find any significant differences when testing whether the effects are larger in firms with less free-riding. I also examine closer how profit sharing affects innovation in firms where the use of profit sharing programs has changed, but I do not find that the firms would have been more innovative in those years when profit sharing was in use.

Keywords corporate innovation, innovation incentives, profit sharing, employee health and safety

Aalto-yliopisto
Kauppakorkeakoulu

Aalto-yliopisto, PL 11000, 00076 AALTO
www.aalto.fi

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Tiivistelmä

Innovatiivisuus on tärkeä osa yrityksen strategiaa, sillä se antaa kilpailuetua ja vauhdittaa yrityksen taloudellista kasvua. Aiemmassa kirjallisuudessa johtoon kuulumattomien työntekijöiden kannustimet sekä aineettomat kannustimet ovat saaneet vain vähän huomiota. Tutkimukseni tarkoitus on lisätä ymmärrystä näistä aihealueista. Tutkin tulospalkkauksen sekä työntekijöiden terveyden ja turvallisuudentunteen vaikutusta yrityksen innovatiivisuuteen. Aineistossani tulospalkkauksella tarkoitetaan sitä, että yrityksen tuloksen ja työntekijöiden kompensaation välillä on selkeä yhteys. Työntekijöiden terveyttä ja turvallisuudentunnetta tutkin niihin liittyvien ongelmien kautta, joita ovat muun muassa onnettomuudet, loukkaantumiset ja kuolemat työpaikalla.

Aineistooni kuuluu 2,686 havaintoa yhdysvaltalaisista yrityksistä ja se on kerätty seuraavista tietokannoista: NBER Patent and Citation Database, MSCI ESG KLD STATS ja Compustat. Mittaan sekä tulospalkkausta että terveyden ja turvallisuuden ongelmia osoitinmuuttujalla. Innovatiivisuuden mittareissa seuraan aiempaa kirjallisuutta ja käytän patenttien ja patenttien sitaattien lukumäärää sekä niitä skaalattuna tutkimus- ja kehityskuluilla. Käyttämiini kontrollimuuttujiin kuuluvat muun muassa yrityksen koko, johdon kompensaatio ja pääomamenot. Tutkimusmetodologiana on PNS-menetelmä ja negatiivinen binomiregressio.

Tutkimukseni korostaa johdon ulkopuolisten ja ei-rahallisten innovaatiokannustimien tärkeyttä. Löydän positiivisen vaikutuksen tutkiessani tulospalkkauksen suhdetta yritysten innovatiivisuuteen, ja vastaavasti negatiivisen vaikutuksen tutkiessani työntekijöiden terveyden ja turvallisuuden ongelmia. Tulokset ovat merkitseviä kaikille edellä mainituille innovatiivisuusmittareille, mutta eivät käyttäessäni tutkimus- ja kehityskuluja innovatiivisuuden mittaamiseen.

Osoitan myös, että tulospalkkauksen ja työntekijöiden terveyden ja turvallisuuden ongelmien vaikutukset yritysten innovatiivisuuteen ovat voimakkaammat niissä yrityksissä, joissa työntekijöiden tärkeys ja panokset ovat merkityksellisempiä. En kuitenkaan löydä merkitseviä tuloksia vertaillessani yrityksiä, joissa on vähemmän vapaamatkustusta. Tarkastelen myös lähemmin niitä yrityksiä, joissa tulospalkkauksen käyttäminen tai käyttämättömyys on muuttunut jonain vuonna. En kuitenkaan tutkimuksessani löydä todisteita sille, että kyseiset yritykset olisivat innovatiivisempia niinä vuosina, kun tulospalkkaus on ollut käytössä.

Avainsanat yritysten innovatiivisuus, innovointikannustimet, tulospalkkaus, työntekijöiden terveys ja turvallisuus

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1 Introduction

1.1 Background

The importance of innovation in companies has gained increased attention in recent years, and it is recognized as a necessary corporate strategy that boosts long-term growth and improves the competitive edge of a firm. Innovation has become an urgent concern to firms, since the lifetime of products has shortened due to an accelerating pace of technological change. Some companies, e.g. start-ups, basically live off innovation. Great ideas arise when there are active, motivated and committed employees in a company. These ideas generate into new products, services and business models, which is what innovation is all about. Because of the clear relationship between innovation and growth among firms, CEOs and researchers have been eager to examine factors that could lead the companies to be more innovative.

Manso (2011) argues that standard pay-for-performance schemes are not enough to incite innovation because they punish failures with low rewards. Since innovation involves intrinsically a high risk of failure, an optimal incentive to innovate should tolerate early failure and reward for long-term success. He also emphasizes the importance of factors like commitment to a long-term compensation plan, timely feedback on performance and job security in order to drive innovation. He states valid executive incentives as for example stock options with long vesting periods, option repricing, golden parachutes and managerial entrenchment.

In real life, ideas typically do not originate from managers but from employees working in the company's bench level. These employees have a cutting edge when it comes to innovation in the company, as they work in areas close to the firm's own technology and interact contiguously with the customers and thus get important information of their needs and wishes. Harden et al. (2008) state that the idea of isolated R&D scientists working in laboratories is outdated as today's organizations value the ideas and insights of employees at all levels of the organization. Rudis (2004) reports that according to CEO surveys, one of the greatest concerns in companies is stimulating innovation and creativity among employees. Still most of the previous empirical work has considered only executive incentives, leaving non-executive incentives without much attention.

1.2 Motivation and research objectives

Since the major role of rank-and-file employees as innovators in today's companies is established, I find it important to examine which non-executive incentives are effective in stimulating corporate innovation. In this thesis, I empirically study the role of profit sharing programs that are targeted to the majority of a firm's employees. My study adds to prior literature on non-executive incentives for innovation, such as stock options and bonuses, and is the first to examine the effect of profit sharing on innovation in U.S. companies. I am also interested in studying the effect of non-financial innovation incentives, as I believe that factors like job satisfaction, employee commitment and welfare are important drivers of innovation activity in companies. This area is very understudied in the prior innovation literature. Thus I examine how health and safety concerns, which affect the whole work force, in a firm impact its innovativeness.

My first hypothesis is that firms with a profit sharing program are more innovative than firms with no profit sharing program. My second hypothesis is that firms with health and safety concerns are less innovative than firms with no health and safety concerns. To test the effect of profit sharing, I use a dummy variable that reveals if a firm has a profit sharing scheme or not. Considering the second hypothesis, I use a dummy variable that captures several serious health and safety concerns a firm can face.

1.3 Main findings and limitations

My data set combines data from NBER Patent and Citation Database, MSCI ESG KLD STATS database and Compustat. The final sample consists of 2,686 observations between 1995 and 2003. I find a positive and significant effect of profit sharing programs on corporate innovation, measured by patents, patent citations and them scaled by R&D expenses. I also find a negative and significant effect of health and safety concerns on the innovation measures. My results are robust to the use of negative binomial regressions instead of standard OLS regressions. However, I do not find significant results when using R&D expenses scaled by assets as innovation measure. In additional research, I find that the effects of profit sharing and health and safety concerns on innovation are more pronounced in those firms, where the input of non-executive employees is stronger. Additionally, I test if the effects are larger in firms with less free-riding, but I do not find any significant differences. I also examine closer those firms in the sample that have experienced a change in the use of profit sharing in some year(s). I do not find that the firms would have been more innovative in those years when profit sharing was in use.

It is possible that my results suffer from endogeneity issues: omitted variables or reverse causality. In addition, the results concerning health and safety concerns may suffer from small sample bias. My data consists of U.S. firms, and the results are not necessarily applicable to other areas.

1.4 Structure

The rest of the thesis proceeds as follows. In Section 2, I provide a review of the relevant literature on corporate innovation, profit sharing and employee health and safety, and state theoretical arguments for the hypotheses. In Section 3, I state the research question and introduce the data, sample and summary statistics. In Section 4, I present and discuss the empirical results of the baseline models. I also show alternative models with negative binomial regressions instead of OLS regressions and R&D expenses as innovation measure, and discuss possible endogeneity issues. In Section 5, I conduct some further research by studying firms that have changing status of profit sharing, and dividing the sample based on the effect of employee importance and free-riding among employees. Section 6 concludes.

2 Literature review and theoretical arguments

I examine the effects of profit sharing and employee health and safety on corporate innovation, and thus the related literature can be divided into three parts: profit sharing, health and safety and innovation. First, I introduce some general notions about corporate innovation, after which I present literature on innovation incentives. Then I continue with literature related to profit sharing programs and employee health and safety. Finally, I propound theoretical arguments based on prior literature both against and in favour of my hypotheses.

2.1 Corporate innovation

The Solow growth model implies that capital accumulation is not the main driver of long-run growth. Instead, the theory suggests that technological change, and therefore innovation, is the key factor to ensure and strengthen long-term economic growth and competitive advantage of countries (Solow, 1957), and the same holds for organizations (Baregheh et al., 2009). The enhancement of innovation represents an increasingly central problem for firm survival and competitiveness. Therefore, the topic is of interest to researchers, and the related literature is extensive.

Though the link between innovation and economic growth has long been recognized, the views have shifted radically from the early neo-classical approaches, which perceived knowledge and technology as completely exogenous to the system. It was seen that the same technological opportunities were equally available to individuals and firms in all places, and that in the long term the pace of technological progress would be the same everywhere. (Howells, 2005) Joseph Schumpeter (1883-1950) was among the first economists to identify the essentialness of innovation. He constructed a theory of economic development, where the innovation process is one of the three key elements of economic growth (Ruttan, 1959). In his theory, change and economic progress are correlative, and entrepreneurship is the driving force. The entrepreneur contributes by introducing new production methods and products, expanding markets and novel management techniques. As a result of successful innovation, the entrepreneur achieves entrepreneurial profit, and the economy as a whole benefits from technological progress. This leads to economic development.

Defining innovation is challenging, as the word is not rigorously defined but has a number of meanings. Based on a content analysis, Baregheh et al. (2009) suggest a generic definition of innovation: "Innovation is the multi-stage process whereby organizations transform ideas into new or improved products, services or processes, in order to advance, compete and differentiate themselves successfully in their marketplace." Smith (2005) offers a shorter definition, stating that innovation is novelty: the creation of something new. The Oslo Manual (OECD, 2005) defines innovation as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations." All of these definitions associate innovation with something new.

To understand innovation, it is helpful to differentiate innovation and invention. Invention fundamentally means coming up with new ideas, while for being an innovation, those ideas need to be brought to the market. Fagerberg (2005) notes that while inventions can be made anywhere, innovations are mostly made in corporations. Schumpeter has argued that "as long as they are not carried into practice, inventions are economically irrelevant." (Scherer, 1986) To turn an invention into an innovation, the firm needs to combine multiple factors: knowledge, capabilities and resources. Kline and Rosenberg (2010) state that successful innovation requires balancing the demands of the new product and its manufacturing processes and the market needs, as well as maintaining an organization that supports the innovation process effectively. Scherer (1986) notes that once the necessary inventions are available, reaching the innovation stage relies strongly on the human and material resources, as well as the firm's ability to tolerate costly and time-consuming trials and errors.

Thinking of innovation as just new products is a mistake. There are at least five different types of innovation: new products, new methods of production, new sources of supply, the exploitation of new markets, and new ways to organize business (Fagerberg, 2005). Holmstrom (1989) denotes that the innovation process is long, idiosyncratic, and unpredictable, and does not follow a linear model. Due to the multidimensional novelty involved in the innovation process, there is no general way of measuring the importance or impact of innovation (Smith, 2005). Also Acs et al. (2002) admit that the measurement of economically useful new knowledge is problematic. However, they show empirical evidence suggesting that patents provide a fairly reliable, although not perfect, measure of innovative activity. Nagaoka et al. (2010) add that information on patent citations (the number of times a patent is cited in other patents) provide very useful information on the value of patents and therefore on the value of innovation.

Baregheh et al. (2009) underline the importance of corporate innovation as a response to persistently changing customer demands, and as a way to utilize opportunities offered by technology and changing marketplaces, structures and dynamics. Firms seem to understand the worth of innovation, as Guiso et al. (2015) notice that 80% of the Standard and Poor's 500 companies advertise innovation as a part of their company values. Given the value of innovation for a company to survive, it is a priority to examine the factors that determine incentives to innovate.

2.2 Incentives to innovate

A central characteristic of innovation is uncertainty, deriving from a very high probability of failure (Holmstrom, 1989). Since innovation is defined as the creation of something new, the process ineluctably contains elements that are not comprehended in the beginning (Kline and Rosenberg, 2010). Holmstrom (1989) and Manso (2011) suggest that a valid innovation incentive tolerates early failure and concentrates on rewarding long-term success. Chang et al. (2013) complement the theory by showing that conservative accounting, which relies on managerial myopia, results in decreased tolerance for early failures and hampers innovation. Tian and Wang (2014) find that Initial Public Offering (IPO) firms backed by more failure-tolerant venture capital investors are significantly more innovative, and failure tolerance is especially important for ventures that are subject to high failure risk. Acharya et al. (2009) show that labour laws that do not punish short-run failures of employees spur corporate innovation.

Xuan Tian has been involved in multiple studies considering corporate innovation, and one important theme in his studies has been the relation between various stock market characteristics and firms' incentives to engage in innovative activities. A study from 2012 (He and Tian) shows that firms covered by a large number of analysts generate less corporate innovation, which is consistent with the hypothesis that analysts pressure managers to meet short-term goals, hindering firms' investments in long-term innovative projects. Another study (Fang et al., 2014) points out that an increase in stock liquidity causes a reduction in future innovation. The possible reasons are the increased exposure to hostile takeovers, which can pressure managers to cut long-term intangible investments such as innovation, and higher presence of institutional investors, who may pressure the management to cut innovation investments and concentrate on short-term earnings. On the other hand, Aghion et al. (2013) argue that greater institutional ownership actually enhances innovation, because CEOs in these firms are less likely to be fired even after poor company performance, which reduces managerial myopia.

Blanco and Wehrheim (2017) find that firms with more options trading activity obtain more patents and patent citations scaled with R&D expenses. They argue that this derives from the enhanced informational efficiency caused by options, which leads to an improved allocation of corporate resources into innovation activities. Acharya and Xu (2017) show that public firms in external finance dependent industries (but not in internal finance dependent industries) spend more on R&D and achieve a better patent portfolio than their private counterparts, indicating that the effect of public listing on innovation depends on the demand for external capital. Ferreira et al. (2012) argue that since private firms are less transparent to outside investors than public firms, they are more tolerant of failure and thus invest more in innovative projects. Balsmeier et al. (2017) have studied the role of independent boards on innovation. They find that firms that undergo a transition to more independent boards apply for more patents and receive more total future citations to their patents.

The existing literature on how managers' characteristics affect corporate innovation includes the study of Hirshleifer et al. (2012). They find that overconfident CEOs invest more in innovation and achieve greater innovative success, because overconfident managers accept greater risk. However, the effects of overconfidence on innovation are mainly found in innovative industries, suggesting that the benefits of overconfidence are mostly pronounced in firms that have strong internal innovative opportunities. Hirshleifer et al. (2012) use proxies for CEO overconfidence based on options exercise and press coverage. Sunder et al. (2017) continue the theme by finding that firms led by pilot CEOs generate greater innovation success. They use CEOs' hobby of flying small aircraft as a proxy for sensation seeking, which combines personal risk taking and desire to pursue novel experiences. They argue that in addition to overconfidence, sensation seeking is a personality trait that can be used to identify CEOs who are likely to drive innovation success. Barker and Mueller (2002) have studied the effect of various CEO characteristics on R&D spending. They find that firms spend more on R&D when CEOs are younger, invest more in firm stock, have significant career experience in marketing or engineering, and hold advanced science-related degrees.

Considering executive incentives, Lerner and Wulf (2007) find that higher compensation levels for the corporate R&D head are associated with more patent awards, more heavily cited patents and more concentrated patents in firms with centralized R&D organizations. However, their results do not hold for firms with decentralized R&D organization. Balkin et al. (2000) show that within high-technology firms, the firm's capability to innovate and CEO pay are related. They find a strong relationship between short-term CEO pay (base salary and bonus tied to performance objectives of one year or less) and innovation, but for long term-term pay (equity-based compensation such as stock options) the results are less consistent. Francis et al. (2011) find that stock options granted to corporate executives as well as golden parachutes have a positive effect on innovation output. Holthausen et al. (1995) find modest evidence that the structure of compensation for the divisional CEO lead to more innovative activity within the division.

Most of the previous studies of innovation incentives consider managerial incentives, while non-executive incentives, which I focus on, remain as a more underexplored topic. Some contributors to the topic are for instance Baccara and Razin (2009), who argue that an innovation bonus encourages employees to bring up their ideas and leads to innovation. Chang et al. (2015) find that non-executive employee stock options have a positive effect on innovation output through enhancing employees' risk-taking incentives. Their study highlights the role of rank-and-file employees as important innovators for companies. Sims (2003) notes that some companies pay high bonuses to the employees responsible for innovations in order to enhance innovation, but this approach may only provide short-term benefits without taking into account the long-term implications.

In addition to incentives, there is some literature on the barriers to innovation. Galia and Legros (2004) find that among postponed projects, the most important obstacles for firms are economic risk and the shortage of qualified personnel. For firms that abandoned innovative projects, the reasons were mainly due to excessive economic risk and high expenses of innovation. Mukherjee et al. (2017) show that higher state-level corporate taxes hamper innovator incentives and reduce willingness to take risks. Savignac (2008) find that financial constraints significantly hamper the likelihood that firms engage in innovative activities. Mohnen et al. (2008) continue that financial constraints decrease innovative activity even if the country's tax treatment of R&D is favourable to innovations, there are programs that support small innovative firms or the venture capital sector has recently experienced a significant growth. D'Este et al. (2012) recognise two different types of obstacles firms may face when undertaking innovation activity: revealed and deterred effects of barriers. Revealed barriers reflect the difficultness of the innovation process and the learning experience, and deterring barriers cover the obstacles that prevent firms from engaging in innovation activity.

2.3 Profit sharing

Profit sharing refers to a plan that aims to share a direct stake of company profits with its employees. The definition is broad, since there are multiple variations of how profit sharing can be executed. For example, the percentage of profits divided to employees can be fixed or vary depending on certain factors. Profit sharing is not a new invention, as it has existed for decades as a way to tie employees' salaries to company profits. The early support for profit sharing was mostly ideological, as many proponents saw profit sharing as a way to integrate workers into the capitalist system in a more direct and tangible way than with fixed wages. Profit sharing could also be seen as a logical extension of political democracy. Nowadays the support for profit sharing is based more on economic reasons. The underlying argument is that profit sharing can motivate employees to work harder and thus increase the productivity of the whole company. (Kruse, 1993)

The literature on profit sharing consists mostly of its impact on various firm characteristics. Pêrotin and Robinson (2002) argue that profit sharing can increase the firm's demand for labour and its level of employment by increasing productivity and by decreasing the marginal cost of labour. Kraft and Ugarkovic (2006) show a positive correlation between profit sharing and profitability in German companies. Wilson and Peel (1991) show that firms with participation schemes such as profit sharing had significantly lower absenteeism and quit rates than firms without such schemes. The most examined variable is however productivity, and Pêrotin and Robinson (2002) summarize the many studies as follows: "There is remarkable agreement across studies from more than 20 countries covering several tens of thousands of enterprises that financial participation has a positive or neutral effect on productivity."

The prior research about the relation between profit sharing and innovation is limited, and the definition of both profit sharing and innovation varies, making it difficult to derive conclusive evidence. Kanama and Nishikawa (2017) find evidence that Japanese companies with a performance-based evaluation system based on R&D performance are more likely to develop new products and services and achieve greater technological superiority. However, they also argue that for large Japanese companies, monetary compensation has a negative impact on the development of new products and services. The reason might be that employees see the distribution of resources as a zero-sum game and lose the motivation to collaborate, and thus innovate, with their colleagues. The study concludes that for achieving better innovation results, it is more desirable to build an evaluation system that reflects research performance rather than just introducing a compensation system.

The study "Profit sharing and innovation" by Aerts et al. (2015) is closely linked to my thesis, but they have a different approach to the subject. The main finding is that profit sharing fosters product innovation but has no effect on process innovation. Their study differs from my study, as their data consist of survey data on German companies (I use U.S. companies) and they gauge innovation by new processes and products developed in the company, which they measure with several indicators (I use patents, patent citations and R&D expenses). Despite the different approach, the studies are consistent with each other as both find a positive effect of profit sharing on corporate innovation. To the best of my knowledge, no other studies have examined the impact of profit sharing on the innovative performance of companies.

2.4 Employee health and safety

The importance of well-being, health and safety at work has raised growing interest, as it is recognized that an employee's physical, emotional, mental and social experiences in the workplace affect the person's productivity and ability to work (Danna and Griffin, 1999). Baker and Green (1991) note that the changes in attitudes are significant, as at the beginning of the industrial revolution employees were mostly viewed as interchangeable gears in a production machine. Now more importance is placed on understanding and promoting employee health. Boyd (1997) states that overstressed workers may respond to poor health and well-being with illegal or unethical activities, such as making lower quality decisions, covering up incidents at workplace, and lying to customers.

The growing awareness of employee safety and health concerns has led to the development of a wide range of health promotion programs and programs which aim to improve the safety of the workplace. Wolfe et al. (1994) define employee health management programs (EHMPs) as long-term organizational activities, which promote the adoption of personal behaviors that improve employee health. Employee health components are for example exercise, stress management, accident prevention and health risk evaluation. Conrad (1988) states that the outcomes of such programs have been improved employee health and fitness, decreased medical costs and absenteeism, improved morale and job satisfaction, increased production, and a better corporate image. Wolfe et al. (1994) add that EHMPs have been found to enhance job performance and company turnover, but they remark that it is often difficult to differentiate the effect of EMPHs from for example employees' personality or attitudinal factors.

Health and safety in the workplace can be seen to be part of two more common concepts: corporate social responsibility (CSR) and corporate culture. There are several definitions of these concepts. Corporate culture is a set of norms and values shared in an organization. They define the rules and context for social interaction and communication in the workplace. (O'Reilly and Chatman, 1996) Kotter (2008) defines that in a strong corporate culture, all managers and employees share similar values and methods of doing business. Strong cultures enhance the level of motivation among employees and avoid suffocating formal bureaucracy that can hamper motivation and innovation. The annual Great Place to Work® survey strives to assess a company's culture with two data sets: the Culture Audit Survey© and the Trust Index© employee survey. The latter captures employees' level of trust towards management, and one variable included is safety, which is assessed by asking employees if they feel that their workplace is a physically safe place to work in.

Abagail (2015) explains that CSR covers actions of firms that contribute to social welfare and go beyond what is required for profit maximization. He continues that as consumers and investors have developed a clear preference for socially responsible firms, companies have in general responded positively and developed their CSR skills. MSCI ESG KLD STATS is an annual dataset that gathers social performance indicators of U.S. firms, and they use several dimensions that can be seen as determinants of the quality of firm CSR: community, human rights, employee relations (including health and safety), product quality and safety, diversity, governance, and controversial business involvement (for example alcohol, tobacco and firearms). Asongu (2007) notes that not only is society expecting companies to be good corporate citizens, it is also becoming less and less tolerant of companies that fail to address their social responsibilities.

Guiso et al. (2015) examine which dimensions of corporate culture affect firm profitability. They find that a culture of integrity and trust correlates positively with financial performance. Kotter (2008) introduces four studies, in which were found that a corporate culture that emphasizes key managerial stakeholders (customers, owners and employees) can have a significant impact on a company's long-term economic performance. Rashid et al. (2003) find a significant correlation between corporate culture and organisational commitment and loyalty in Malaysian companies, and that both of these factors have an impact on profitability measures.

Many studies have examined the link between CSR and financial performance. The variation in results is high, mostly since the measurement of CSR is difficult. Those arguing for a negative relationship suggest that firms performing responsibly cause a competitive disadvantage due to incurring costs that might otherwise be avoided (Waddock, 1997). A number of studies (e.g. Aupperle, 1985) find a neutral relationship between CSR and financial performance, so that there is no positive nor negative relationship. The supporters of non-existing correlation argue that due to several intervening variables between social and financial performance, there is no reason to expect a relationship to exist. Some studies find a positive relationship between CSR and financial performance, which is supported by the view that the costs are minimal while the potential benefits are great. For example, an enlightened employee relations policy may cost very little, but can result in increase in morale and productivity and thus add competitive advantage in comparison to less responsible firms. (Waddock, 1997)

To the best of my knowledge, no studies have examined the impact of employees' health and safety on corporate innovation. However, Tellis et al. (2009) examine the relationship between internal corporate culture and radical innovation across nations. They argue that the corporate culture in some innovative firms (for example Samsung in Korea and Infosys in India) build up precisely to overcome barriers of their home economies that would otherwise hinder radical innovation.

2.5 Theoretical arguments

There are some arguments why the effect of profit sharing on corporate innovation may be non-existent. Several previous studies (e.g. Kohn, 1993) suggest that pay for performance incentives work well for encouraging something that has succeeded in the past, but not for tasks which require creativity and innovation. Such incentives do not encourage early failure, which is a key factor for a valid innovation incentive (Holmstrom, 1989). As Ederer and Manso (2013) emphasize, the performance-based financial incentive needs to be specially structured, so that it tolerates early failure and rewards long-term success in order to stimulate innovation. According to these statements, the positive correlation between profit sharing and innovation is questionable as the nature of profit sharing fits better standard performance pay than the latter description.

Chang et al. (2015) find a positive effect of stock options on corporate innovation, and stock options and profit sharing are both key employee compensation tools. Nevertheless, the incentive period of stock options is longer. For instance Lerner and Wulf (2007) find a clear relationship between long-term incentives and innovation, but no relation when it comes to short-term incentives.[1] Thus positive correlation between stock options and corporate innovation does not necessary hold for profit sharing and innovation. Also Pêrotin and

[1] Lerner and Wulf (2007) define long-term incentives as equity-based pay like stock options and restricted stock. Short-term incentives they define as for example bonus plans that are linked to annual performance.

Robinson (2002) suggest that the benefits of cash schemes are more short-term than with deferred or share based schemes.

Though the incentive period of profit sharing is short, it is reasonable to argue that it has a stimulating effect on employees' incentives to actively support and contribute to the firm's innovation activities. Aerts et al. (2015) point out that profit sharing leads the company owners and employees to share a mutual interest: profit maximization. Since innovations are expected to increase the firm's future profits, they benefit both parties. When employees get their share of any profit increase, they probably are more eager to invest in the innovative performance of the firm and share their ideas with the management. Ederer (2009) find that innovation performance is highest when employees receive a group incentive that rewards long-term joint success, making a shared compensation system such as profit sharing potentially a valid innovation incentive. As Smith (2005) argues, innovation relies on collaboration and interactive learning, and incentives that enhance teamwork lead to more successful innovations.

Theoretical arguments available for innovation incentives consider mostly financial incentives, which employee health and safety are not. However, non-financial incentives may motivate and engage employees as efficiently as financial incentives. Baccara and Razin (2009) point out that there is a risk that innovative employees leave the firm to build new enterprises with the knowledge they acquire, which increases the need for an incentive strong enough to keep the employees in the firm. If there are no problems with health and safety in the workplace, job satisfaction is likely to be higher, making employees more committed.

Corporate culture has an influence on the firm's innovativeness. For example, Büschgens et al. (2013) comment that hierarchical cultures that emphasize control are less likely to be innovative. Baccara and Razin (2009) note that firms can actively promote creativity through intra-firm practices, such as advanced cross-department communication. Especially the flexible and knowledge-based corporate culture of the Silicon Valley firms has raised much attention as an innovation driver. These companies rely on corporate culture that emphasizes informality, minimization of hierarchy and orientation toward entrepreneurial achievement (Saxenian and Hsu, 2001). I argue that also employee health and safety is an integral part of the corporate culture, and should thus have an impact on innovation.

3 Research questions and data

3.1 Research questions

This paper addresses the impacts of profit sharing programs and health and safety concerns on corporate innovation. The two hypotheses are stated as follows:

H_1: Firms with a profit sharing program are more innovative than firms with no profit sharing program.

H_2: Firms with health and safety concerns are less innovative than firms with no health and safety concerns.

My sample consists of U.S. firms, so the results may not be consistent elsewhere. The question is economically of importance, as innovativeness is a key driver of firm growth. Profit sharing programs are targeted to the majority of the employees, and different health and safety concerns affect the whole work community. Thus the study regards also the stakeholder theory of corporate finance, as it examines the importance of non-executive employees in corporate innovation.

3.2 Data on profit sharing

Because of the importance of rank-and-file employees as innovators, I study the effect of profit sharing programs which target the majority of the work force – not just the top management. A profit sharing program occurs in a firm, when there is a clear link between the profit of the company and the employee compensation in a given period. Kruse (1996) summarizes the goals of implementing a profit sharing program in a firm: to 1) enhance workplace productivity and co-operation, 2) increase compensation flexibility, and 3) discourage unionization and tax incentives. In this thesis I examine whether the first goal succeeds, also if profit sharing increases corporate innovation alongside productivity.

I have obtained data on profit sharing from the MSCI ESG KLD STATS database, which provides social research data related to corporate social responsibility. MSCI collects data on whether a company has a profit sharing program or not. The criteria for having a profit sharing program are that the company has recently made distributions as a result of the program, and that a majority of a workforce participates in it. The database provides data from 1995 onwards. New companies are added to and inactive companies are dropped from the sample every year, resulting in an unbalanced panel structure.

3.3 Data on health and safety

Asongu (2007) notes that in order to a company to identify innovation opportunities, the corporate culture needs to make such identification a priority. He continues that while CSR has been recognized to be relevant to a company's profitability in recent years, the effect on innovation is less examined, yet existing. Managing health and safety in a workplace can be seen to be part of corporate culture and CSR, which makes me interested to examine if there is a correlation between corporate innovation and employee health and safety.

The MSCI ESG KLD STATS database offers data on the health and safety of a firm's employees. MSCI provides a variable that indicates companies with strong employee health and safety programs, but only from 2003 onwards. Thus I use a variable that records the severity of controversies related to the health and safety of a firm's employees, and examine if these issues have a negative effect on corporate innovation. Topics covered in health and safety concerns include, for example, workplace accidents, injuries, and fatalities, mental health issues, as well as kidnappings and physical harm experienced by employees in the field. The variable is available from 1995 onwards and results in an unbalanced panel structure.

3.4 Measuring corporate innovation

To measure innovation output, I follow earlier studies (e.g. Chang et al., 2015 and Acharya et al., 2009) and use a combination of the number of patents and the number of patent citations. In addition I scale them with R&D expenses. The first measure of innovation, patents, indicates the number of patents applied for by a firm in a given year. However, Hirshleifer et al. (2012) point out that patents differ greatly in their importance, so I use citations as the second measure of innovation. The variable indicates the number of citations received by the firm's patents and therefore represents the quality and importance of the patents.

The citation data suffers from truncation bias due to the finite length of the patent data. Patents in the later years have less time to accumulate citations, which is a problem because patents receive citations for a long period of time (Chang et al., 2015). I have addressed this issue by adjusting each patent's raw citation count by multiplying it with the weighting index provided by Hall et al. (2005). The third and fourth measure of innovation is patents/R&D expenses and citations/R&D expenses, which indicate how productive the use of R&D expenses has been in terms of patents and citations. Patents and citations are measured as a sum of years t+1 and t+2 in the regressions, while the other variables are measured at year t.

The data on patents and citations is obtained from the National Bureau of Economic Research (NBER) Patent and Citation Database, which provides information on all U.S. patents granted by the U.S. Patent and Trademark Office (USPTO) between 1976 and 2006. There is, on average, a two-year lag between the date when inventors file for patents (the application date) and the date when patents are granted by USPTO and added to the dataset. Since the last year in the NBER dataset is 2006, patents applied for in 2004 and 2005 may not be completely covered by the database. As suggested by Hall et al. (2001), I end the sample period in 2003 to avoid the issue. Also, when counting patents, I use the application year rather than the grant year since Hall et al. (2001) note that the application date is more relevant and closer to the actual time of invention. Following Hirshleifer et al. (2012), I exclude firms in financial and utility industries (SIC codes: 6000–6999 and 4900–4999, respectively), but this affected only a few observations in my data.

3.5 Control variables

Following the innovation literature, I control for various firm characteristics that may be determinants of corporate innovation. To conduct these control variables, I use financial data which I have obtained from the Compustat files. Hall and Ziedonis (2001) state that large and capital-intensive firms generate more patents, and thus I control for firm size by using the natural log of total revenue. I also use the number of employees to control the size effect, following Veugelers and Cassiman (1999). My results are robust to the use of total assets as a proxy for firm size. I follow Chang et al. (2015) and use R&D/assets to control for tangible input to innovation, the log of the net Property, Plant, and Equipment scaled by the number of employees to account for capital intensity, and the log of net sales scaled by the number of employees to capture labour productivity and quality. The cash-to-assets ratio is used to control for the effects of cash holdings. Following Balsmeier et al. (2017), I account for financial constraints using capital expenditures scaled by total assets. Chang et al. (2015) find that non-executive employee stock options have a positive effect on corporate innovation. Therefore I use a control variable called employee involvement, which identifies companies that have generous employee stock ownership plans or employee stock purchase plans. I also control for year and industry fixed effects. Year fixed effects neutralize the impact of certain events in a given year, and industry fixed effects filter out unobserved time-invariant characteristics of industries.

Additionally, I use the Compustat Executive Compensation database, from which I have obtained data on options and shares received by all firm's directors. I have combined these figures to one variable, executive compensation, since for example Francis et al. (2011) show a positive correlation between executive stock options and innovation. Compustat Executive Compensation also provides the variable return on assets (ROA), which I use to control for operating profitability. All control variables are measured at year t in the regressions.

3.6 Final sample and descriptive statistics

In conclusion, the sample construction occurred as follows. I started with all firms included in the MSCI database on profit sharing programs and health and safety concerns between 1995 and 2003. Then I merged the dataset with the NBER Patent and Citation Database and excluded firms which had no patent information in any year in the entire database. The combined dataset was then merged with Compustat data on control variables described in the previous section. At this point there were altogether 4,787 observations. Next, I excluded all firms which had zero R&D expenses or provided no such information (this step caused the biggest decrease in the sample, dropping to 3,067). I also dropped financial firms and utilities and firm-years with missing values for control variables. After these demarcations, I ended up with a final sample of 2,686 observations between 1995 and 2003.

Columns 1–3 of Table 1 report means, medians and standard deviations, respectively, of the variables used in the final sample. Considering the corporate innovation measures, an average firm in the sample applies for circa 174 patents in two years, and receives 2,269 citations in two years. However, the median 20 for patents and median 83 for citations reveal the high skewness of the patent and citation distributions. Some 15% of the observations have zero patents in two years. I deal with this problem by taking a logarithm of one plus patents and one plus citations and use these logarithms as dependent variables in the regressions. Logarithm transformations are a common procedure to make positively skewed distributions more normal, and the amounts of patents and citations need to be summed with one due to the observations with value zero.

For the third (fourth) innovation measure, patents/R&D (citations/R&D), the mean is 0.59 (6.74) and the median is 0.27 (1.05). Also these variables are clearly skewed, so I take a logarithm of one plus these variables when I use them as dependent variables.

The mean for profit sharing indicates that 19% of the sample firms have a profit sharing program, while the remaining 81% have not. Aerts et al. (2015) state that the relatively low ratio of firms adapting profit sharing programs is caused by firm-specific advantages or disadvantages in respect to different incentive schemes. For example, firms with highly structured work tasks probably find e.g. piece rates a better reward system than profit sharing. It could also be difficult to employ a profit sharing program which is targeted to the majority of the workforce, if the employees exhibit very different qualification levels. The mean for health and safety concerns tells that only 4% of the sample firms have these kinds of issues. This seems rational, as the concerns indicated by this variable are quite severe. However, the small number of firms facing these problems in my sample can lead to small sample bias when studying the effect of health and safety concerns.

The means, medians and standard errors of the control variables reported in columns 1-3 in Table 1 reveal the fundamentals of the characteristics of the firms in the whole sample. Notable is that the sample firms are relatively big with the mean (median) of 28,000 (10,000) employees, compared to the mean (median) of 7,000 (400) for all Compustat firms in 2003. Considering revenue, the mean (median) is $8 billion ($2 billion) for the sample firms, compared to the mean (median) of $2 billion ($0.9 billion) for all Compustat firms in 2003.

Table 1: Summary statistics

The sample consists of 2,686 firm-years jointly covered in the MSCI Database, Compustat and the NBER Patent and Citation Database between 1995 and 2003. *Number of Patents* is the sum of patents in years t+1 and t+2. *Number of Citations* is the sum of patent citations in years t+1 and t+2, which is adjusted using the weighting index of Hall et al. (2005). *Patents/R&D (Citations/R&D)* is the firm's number of patents (citations) in years t+1 and t+2 scaled by R&D expenses in millions in year t. All following variables are reported in year t and in U.S. dollars, if applicable. *Profit sharing* tells if a given firm has a profit sharing program or not (dummy variable). *Health and Safety Concern* indicates if a given firm has health and safety concerns or not (dummy variable). *Employee Involvement* tells if a given firm has generous employee stock ownership plans or employee stock purchase plans or neither (dummy variable). *Assets* represents the value of total assets of a given firm in millions. *Revenue* is the total net sales in millions. *Number of Employees* is reported in thousands. *Executive Compensation* is the sum of options and shares received by all directors in thousands. *ROA* is Return on Assets. *R&D/Assets* is the firm's R&D expenses scaled by total assets. *PPE/#employees* is net Property, Plant, and Equipment (PPE) in millions scaled by the number of employees in thousands. *Revenue/#employees* is revenue scaled by the number of employees in thousands. *Cash/Assets* is cash-to-assets ratio. *Capital Expenditures/Assets* is capital expenditures scaled by total assets.

	Whole sample n = 2,686		
	Mean (1)	Median (2)	Std. Dev. (3)
Number of Patents	173.95	20.00	532.90
Number of Citations	2269.13	82.87	9580.97
Patents/R&D	0.59	0.27	1.01
Citations/R&D	6.74	1.05	21.58
Profit Sharing	0.19	0.00	0.39
Health and Safety Concerns	0.04	0.00	0.20
Employee Involvement	0.23	0.00	0.42
Assets	10609.66	2452.39	37710.89
Revenue	7928.31	2141.39	19547.29
Number of Employees	28.08	10.14	54.41
Excecutive Compensation	5.21	2.40	8.17
ROA	3.43	5.44	20.05
R&D/Assets	0.06	0.04	0.06
PPE/#employees	86.15	49.91	130.33
Revenue/#employees	276.75	220.66	217.10
Cash/Assets	0.10	0.06	0.11
Capital Expenditures/Assets	0.05	0.04	0.04

In Table 2, I have divided the companies into subsamples. Columns 1 and 2 introduce subsamples that are divided according to whether the firms have a profit sharing program or not. Similarly, columns 3 and 4 report subsamples that are divided according to whether the firms have health and safety concerns or not. I report the means of the variables separately to the two groups, and test the significance of the differences in mean values between the two subsamples using the two independent samples t-test (significance levels reported in columns 1 and 3). Additionally, I test for the significance levels for the differences in median values with the Mann–Whitney U test (reported in columns 2 and 4). The results achieved give an indication of the upcoming OLS results, but with the limitation that the effects of control variables are excluded.

When it comes to profit sharing (columns 1 and 2), the table reports a clear and significant difference in innovativeness between these two groups, as the average number of patents is 107 among firms with no profit sharing program and 464 among those with one. Also the number of citations indicate that firms with profit sharing program are more innovative, as they have on average 4.4 times more citations than the firms with no profit sharing. The difference measured by patents/R&D (citations/R&D) is smaller, but still significant at on average 1.6 times (2.2 times) more for firms with profit sharing. These results indicate that there may indeed be a positive effect of non-executive profit sharing on innovation.

The mean differences for the control variables reported in columns 1-2 reveal separately the characteristics for the firms with and without profit sharing programs. Firms with profit sharing programs are bigger: they have on average 1.9 times more employees and 2.5 times more total assets. Companies with profit sharing generate more revenue scaled with the number of employees. Firms with profit sharing programs also seem to give out more executive compensation and engage in employee stock ownership or employee stock purchase plans. The tangible input to innovation (R&D/assets) is slightly higher among the firms with profit sharing. The difference of operating profitability (ROA) is significant only with mean values, but not with median values.

Regarding health and safety concerns (columns 3 and 4), the differences in innovation measures are less clear. The average number of patents is 174 among firms with no health and safety concerns, and 168 among those with these concerns. The difference in patents is significant only with median values. Considering citations, the difference is significant with both mean and median values, and firms with no health and safety concerns have on average 1.4 times more citations than firms facing these issues. Measuring innovation with patents/R&D gives no significant results in differences. With citations/R&D the difference is significant with mean values (but not with median values), and the variable is on average 1.6 times bigger for firms without health and safety concerns than for firms with health and safety concerns. These results give little evidence on the effect of health and safety concerns on corporate innovation.

The mean differences for the control variables reported in columns 3-4 explain the characteristics for the firms with and without health and safety concerns. Those sample firms experiencing health and safety concerns are much bigger with on average 2.9 times more employees and 4.0 times more total assets. They also have a lower cash-to-assets ratio. A bit surprisingly, companies with health and safety concerns yield 1.5 times more revenue scaled with the number of employees than those without.

Table 2: Subsample means

The final data (described in Table 1) has been divided into two subsamples according to whether a firm has a profit sharing program or not, and the means for these separate samples are reported in columns 1 and 2. In columns 3 and 4, the final data has been divided into two subsamples according to whether a firm has health and safety concerns or not, and the means for these separate samples are reported. In columns 1 and 3, the symbols ***, **, and * denote significance of the difference between the subsample means using the two independent samples t-test (Welch's t-test) at the 1%, 5% and 10% levels, respectively. In columns 2 and 4, the symbols ***, **, and * denote significance of the difference between the subsample medians using the Mann–Whitney U test at the 1%, 5% and 10% levels, respectively.

	Cash profit Yes n = 507 Mean (1)	Cash profit No n = 2,179 Mean (2)	Health and Safety Concern Yes n = 116 Mean (3)	Health and Safety Concern No n = 2,570 Mean (4)
Number of Patents	463.50***	106.58***	168.26	174.21***
Number of Citations	6065.85***	1385.72***	1609.62**	2298.90***
Patents/R&D	0.86***	0.53***	0.52	0.60
Citations/R&D	12.23***	5.46***	4.20***	6.85
Profit Sharing	1***	0***	0.26*	0.19
Health and Safety Concerns	0.06*	0.04**	1***	0***
Employee Involvement	0.35***	0.20***	0.23	0.23
Assets	20594.62***	8286.41***	37662.65***	9388.59***
Revenue	15303.65***	6212.25***	29787.47***	6941.67***
Number of Employees	45.13***	24.11***	75.04***	25.96***

Excecutive Compensation	6.12***	5.00***	1.70***	5.37***
ROA	5.44***	2.97	3.06	3.45***
R&D/Assets	0.07***	0.06***	0.03***	0.06***
PPE/#employees	109.44***	80.74***	204.42***	80.82***
Revenue/#employees	314.48***	267.98***	411.23***	270.68***
Cash/Assets	0.10	0.10	0.04***	0.11***
Capital Expenditures/Assets	0.06***	0.05***	0.05	0.05***

4 Methodology and results

4.1 Methodology

I study the effects of profit sharing programs and health and safety concerns on corporate innovation using standard OLS regressions. To provide comparable results, my models rely strongly on the model used by Chang et al. (2015) to examine the effect of employee stock options on corporate innovation.

The baseline models are as follows:

(1) $Ln(1+Innovation_i) = \beta_0 + \beta_1 Profit\ Sharing_{i,t} + \beta_2 X_{i,t} + \beta_3 Industry_{i,t} + \beta_4 Year_t$

(2) $Ln(1+Innovation_i) = \beta_0 + \beta_1 Health\ and\ Safety\ Concerns_{i,t} + \beta_2 X_{i,t} + \beta_3 Industry_{i,t} + \beta_4 Year_t$

$Innovation_i$ refers to the four innovation measures which I examine separately: patents, citations, patents/R&D expenses and citations/R&D expenses. Patents indicate the sum of patents of firm *i* in years *t*+1 and *t*+2. Citations indicate the sum of citations of firm *i* in years *t*+1 and *t*+2. Patents/R&D expenses (citations/R&D expenses) is the patents (citations) in years *t*+1 and *t*+2 scaled by the number of R&D expenses in year *t*. To reduce skewness in innovation measures, I use the logarithm of one plus these variables in the regression analysis. $X_{i,t}$ includes the control variables discussed in Section 3.5 for firm *i* in year *t*. In model (1), the variable on health and safety concerns is interpreted as control variable, and similarly in model (2) profit sharing is defined as control variable. $Industry_{i,t}$ is the two-digit SIC industry fixed effects and $Year_t$ is the year fixed effects.

4.2 Results from the baseline models

Table 3 reports the results of the regressions on the baseline models. Considering equation (1), I find that profit sharing is positively and significantly correlated with all four innovation measures: *Ln*(1+*Patents*), *Ln*(1+*Citations*), *Ln*(1+*Patents/R&D Expenses*) and *Ln*(1+*Citations/R&D Expenses*) with t-statistics 5.2, 4.8, 4.2 and 4.8, respectively. The coefficients of profit sharing are 0.39, 0.50, 0.08 and 0.21 when regressing on patents, citations, patents/R&D expenses and citations/R&D expenses, respectively. For example, if a firm has no profit sharing and applies for 20 patents in two years (the sample median), the implementing of a profit sharing program would raise the number of patents with 49% according to these results.[2] Of course in reality the change would not be that straightforward. Nevertheless, my results indicate a clear difference in innovation output for firms with and without profit sharing programs. These results add to the previous literature on non-executive incentives on innovation, such as the positive effect of an innovation bonus (Baccara and Razin, 2009), and employee stock options as a valid innovation incentive (Chang et al., 2015). My results are also in line with those of Aerts et al. (2015), who find that profit sharing fosters product innovation among German companies.

The results for equation (2) for health and safety concerns are also significant with t-statistics -4.0, -3.8, -1.9 and -3.1 and coefficients of -0.63, -0.73, -0.06 and -0.25 when regressing on patents, citations, patents/R&D expenses and citations/R&D expenses, respectively. The findings imply that if a firm without health and safety concerns applies for 20 patents in two years, the emergence of these problems would reduce the number of patents with 49%.[2] Once again, the implication is not that simple, but the results indeed suggest that health and safety concerns have a negative effect on corporate innovation. My results add to the previous literature on employee health and safety which are linked with CSR and corporate culture, where the relationships with corporate innovation is highly understudied. However, e.g. Büschgens et al. (2013) and Baccara and Razin (2009) argue that the nature of corporate culture

[2] The number one in *Ln*(1+*Innovation*$_i$) makes the interpreting of the log-level model somewhat different from standard interpret. The exact percentage difference for profit sharing is calculated with the following formula (the same holds for health and safety concerns):

$$\frac{Patents_{profitsharing} + 1 - (Patents_{no\ ps} + 1)}{Patents_{no\ ps} + 1} = e^{\beta 1} - 1$$

$$\frac{Patents_{profitsharing} - Patents_{no\ ps}}{Patents_{no\ ps}} = \frac{Patents_{no\ ps} + 1}{Patents_{no\ ps}}(e^{\beta 1} - 1)\,, Patents_{no\ ps} > 0$$

affects innovation, which is in line with my results. Generally, there is a lack of previous studies of non-monetary incentives to innovate.

Untabulated statistics reveal that Variance Inflation Factor (VIF) is below 2.9 for all variables in all regressions, and therefore multicollinearity is not a problem in my sample. The adjusted R-squared is on average 0.51. The relatively high value is partly explained by fixed effects, as eliminating the industry and year fixed effects from the regressions decreases the average adjusted R-squared to 0.30.

Table 3: Effects of profit sharing and health and safety concerns on corporate innovation

The sample consists of 2,686 firm-years jointly covered in the MSCI Database, Compustat and the NBER Patent and Citation Database between 1995 and 2003. *Patents* is the sum of patents in years t+1 and t+2. *Citations* is the sum of patent citations in years t+1 and t+2, which is adjusted using the weighting index of Hall et al. (2005). *Patents/R&D (Citations/R&D)* is the firm's number of patents (citations) in years t+1 and t+2 scaled by R&D expenses in year t. All following variables are reported in year t and in U.S. dollars, if applicable. *Profit sharing* tells if a given firm has a profit sharing program or not (dummy variable). *Health and Safety Concerns* tells if a given firm has experienced issues with health and safety (dummy variable). *Employee Involvement* tells if a given firm has generous employee stock ownership plans or employee stock purchase plans or neither (dummy variable). *Revenue* is the total net sales in millions. *Number of Employees* is reported in thousands. *Executive Compensation* is the sum of options and shares received by all directors in thousands. *ROA* is Return on Assets. *R&D/Assets* is the firm's R&D expenses scaled by total assets. *PPE/#employees* is net Property, Plant, and Equipment (PPE) in millions scaled by the number of employees in thousands. *Revenue/#employees* is revenue scaled by the number of employees in thousands. *Cash/Assets* is cash-to-assets ratio. *Capital Expenditures/Assets* is capital expenditures scaled by total assets. Constant terms are included in the regressions but are not reported due to irrelevancy. In parentheses are the t-statistics, which are calculated using robust standard errors. The symbols ***, **, * and . denote significance at the 0.1%, 1%, 5% and 10% levels, respectively.

	Ln(1+patents)	Ln(1+citations)	Ln(1+Patents/R&D)	Ln(1+Citations/R&D)
	OLS	OLS	OLS	OLS
Profit Sharing	0.386***	0.496***	0.076***	0.214***
	(5.20)	(4.80)	(4.21)	(4.76)
Health and Safety Concerns	-0.627***	-0.730***	-0.057.	-0.251**
	(-3.96)	(-3.76)	(-1.88)	(-3.12)
Ln(Revenue)	0.730***	0.840***	0.007	0.065***
	(24.85)	(20.80)	(1.25)	(4.49)
Number of Employees	0.004***	0.005***	0.000**	-0.001*

	(4.22)	(4.17)	(-2.79)	(-1.98)
Excecutive Compensation	0.007.	0.007	-0.001	0.000
	(1.94)	(1.28)	(-2.07)*	(0.10)
Employee Involvement	-0.026	-0.088	-0.075***	-0.154***
	(-0.38)	(-0.90)	(-4.58)	(-3.60)
ROA	0.001	0.001	0.000***	0.001*
	(0.47)	(0.51)	(4.07)	(2.31)
R&D/Assets	7.322***	8.502***	*)	*)
	(9.57)	(8.19)		
Ln(PPE/#employees)	0.437***	0.522***	0.049***	0.105**
	(7.93)	(6.26)	(3.67)	(2.84)
Ln(Revenue/#employees)	-0.371***	-0.517***	-0.073***	-0.157***
	(-5.17)	(-5.03)	(-4.54)	(-3.84)
Cash/Assets	0.756*	1.505***	-0.184**	0.080
	(2.44)	(3.35)	(-3.06)	(0.53)
Capital Expenditures/Assets	1.170	1.604	1.048**	2.578***
	(1.30)	(1.23)	(3.23)	(3.57)
Industry and Year Fixed Effects	Included	Included	Included	Included
N/adjusted R-squared	2,686/0.60	2,686/0.65	2,686/0.28	2,686/0.51

*) R&D/Assets is excluded from these regressions to account for the issue that R&D is used in both dependent and independent variables.

The coefficients of control variables are mostly in line with prior innovation literature. Larger firms clearly have more patents and citations when measured by total revenue, but when measured by the number of employees the coefficients are near zero. I discuss the meaning of the number of employees further in Section 5.3. I do not find a significant effect of return on assets or executive compensation on any of the corporate innovation measures. Unexpectedly, employee involvement (employee stock ownership or purchase plans) has a negative effect on innovation when measured by patents and citations scaled by R&D expenses. I find a positive and significant effect of the cash-to-assets ratio on innovation when measured by patents and citations, and the level of capital expenditures (scaled by total assets) has a positive and significant effect on patents/R&D expenses and citations/R&D expenses. Capital intensity affects innovation positively, but surprisingly labour productivity seems to have a negative effect. I further address the impact of skilled labour in Section 5.2. As expected, larger R&D expenditures are strongly correlated with higher corporate innovation. The correlation is in fact so vivid, that in next section I introduce an alternative regression in which I use R&D expenses as innovation measure.

4.3 Robust check with negative binomial regressions

Patent and citation counts are non-negative and discrete, which makes it plausible to use negative binomial regressions instead of standard OLS regressions. Negative binomial regression is a generalization of Poisson regression, but it is more flexible as it does not require the response variable's variance to be equal to its mean. I follow Chang et al. (2015) and test whether my models are robust to this alternative model specification. In negative binomial regressions, the dependent variables are the numbers of patents and citations and them scaled by R&D expenses, not their logarithmic values as in standard OLS regressions.

The test results in Table 4 give similar results as in the previous section. Profit sharing is positively and significantly correlated with all four innovation measures: patents, citations, patents/R&D expenses and citations/R&D expenses with coefficients of 0.32, 0.26, 0.25 and 0.22 and with t-statistics 4.8, 2.6, 3.7 and 3.0, respectively. Health and safety concerns are negatively and significantly correlated with all innovation measures used. T-statistics are -4.9, -4.8, -2.1 and -3.9 and the coefficients are -0.61, -0.87, -0.30 and -0.53 when regressing on patents, citations, patents/R&D expenses and citations/R&D expenses, respectively. The same control variables are included as in equations (1) and (2), but they are not tabulated for the sake of brevity.

Table 4: Negative binomial regressions

The sample consists of 2,686 firm-years jointly covered in the MSCI Database, Compustat and the NBER Patent and Citation Database between 1995 and 2003. *Patents* is the sum of patents in years t+1 and t+2. *Citations* is the sum of patent citations in years t+1 and t+2, which is adjusted using the weighting index of Hall et al. (2005).

Patents/R&D (Citations/R&D) is the firm's number of patents (citations) in years t+1 and t+2 scaled by R&D expenses in year t. *Profit sharing* tells if a given firm has a profit sharing program or not (dummy variable). *Health and Safety Concerns* tells if a given firm has experienced issues with health and safety (dummy variable). All regressions in this table include constant terms and the control variables used in Table 2, but the coefficients are not reported due to irrelevancy. In parentheses are the t-statistics, which are calculated using robust standard errors. The symbols ***, **, * and . denote significance at the 0.1%, 1%, 5% and 10% levels, respectively.

	Patents NBG	Citations NBG	Patents/R&D NBG	Citations/R&D NBG
Profit Sharing	0.322***	0.257**	0.250***	0.217**
	(4.77)	(2.63)	(3.73)	(3.04)
Health and Safety Concerns	-0.613***	-0.870***	-0.295*	-0.530**
	(-4.90)	(-4.79)	(-2.10)	(-3.90)

4.4 R&D as innovation measure approach

Quantifying and measuring innovation is not all that simple. Are patents and patent citations really the best way to assess innovation? Smith (2005) argues that the main weakness of using patents to measure innovation is that they are an indicator of invention rather than innovation. Patents mark the emergence of new technical principles but miss all commercial innovations, which cannot be patented (e.g. new business strategies). In short, not all innovations are patented, but they can still be technologically and economically significant.

Though Smith (2005) concludes in his final analysis that the patent system does have a striking advantage as an innovation measure since it gathers detailed information on inventive activity, I choose to do an additional regression with research and development expenses as the innovation measure. It may be seen as a valid measure for innovation, as investments in R&D lead to innovations and in most cases firms must invest in R&D in order to innovate in the first place. There is some empirical evidence supporting the hypothesis that R&D expenses are a prompt proxy for innovation activities (e.g. Shefer and Frenkel, 2005). The obvious problem with R&D expenses is that it measures only input, missing the actual output entirely.

The models with R&D Expenses as dependent variable are as follows:

$$(3)\quad R\&D_{i,t}/Assets_{i,t} = \beta_0 + \beta_1 Profit\ Sharing_{i,t} + \beta_2 X_{i,t} + \beta_3 Industry_{i,t} + \beta_4 Year_t$$

$$(4)\ R\&D_{i,t}/Assets_{i,t} = \beta_0 + \beta_1 Health\ and\ Safety\ Concerns_{i,t} + \beta_2 X_{i,t} + \beta_3 Industry_{i,t} + \beta_4 Year_t$$

The dependent variable refers to the R&D expenses in year t scaled by assets in year t. All independent variables are the same as in the baseline models (1) and (2), except R&D/assets which is of course excluded.

Table 5 reports the results of the regression on equations (3) and (4). Interestingly, I find significant results for all control variables, but not for neither profit sharing nor health and safety concerns. According to the regression output, firms with profit sharing programs have a small positive impact on R&D expenses scaled by total assets, but the result is not significant with a p-value of 0.27. Health and safety concerns in turn have a slightly negative effect on the innovation measure, but again there is no significance with a p-value of 0.38. Thus I cannot find proof for H_1 nor H_2 when corporate innovation is measured by R&D expenses. However, as Scherer (1986) notes, there is no general correlation between R&D expenses and the importance of innovations produced, and therefore R&D expenses are not a very good measure of innovation.

Table 5: Effect of profit sharing and health and safety concerns on R&D Expenses scaled by assets

The sample consists of 2,686 firm-years jointly covered in the MSCI Database, Compustat and the NBER Patent and Citation Database between 1995 and 2003. *R&D/Assets* is the firm's R&D expenses in year t scaled by total assets in year t. *Profit sharing* tells if a given firm has a profit sharing program or not (dummy variable). *Health and Safety Concerns* tells if a given firm has experienced issues with health and safety (dummy variable). Descriptions for the control variables can be found in Table 2. Constant term is included in the regressions but is not reported due to irrelevancy. In parentheses are the t-statistics, which are calculated using robust standard errors. The symbols ***, **, * and . denote significance at the 0.1%, 1%, 5% and 10% levels, respectively.

	R&D/Assets OLS
Profit Sharing	0.003
	(1.10)
Health and Safety Concerns	-0.003
	(-0.88)
Ln(Revenue)	-0.007***

	(-6.00)
Number of Employees	0.000***
	(3.38)
Excecutive Compensation	0.001***
	(5.42)
Employee Involvement	0.014***
	(6.14)
ROA	-0.000**
	(-3.15)
Ln(PPE/#employees)	-0.004*
	(-2.13)
Ln(Revenue/#employees)	0.014***
	(3.91)
Cash/Assets	0.114***
	(8.33)
Capital Expenditures/Assets	0.227***
	(6.40)
Industry and Year Fixed Effects	Included
N/adjusted R-squared	2,686/0.39

The median of the variable R&D/assets is only 0.04, which explains the small yet significant coefficients for the control variables. Notable is, that the effect of employee involvement is positive with a coefficient of 0.01, as opposed to the regressions in Table 3. This could imply that firms investing in employee involvement via stock ownership or purchase plans also invest more in R&D. The coefficient of total revenue is -0.01, indicating that larger firm size does not lead to more expenditure on R&D. The Variance Inflation Factor (VIF) is below 2.9 for all variables, meaning that multicollinearity is not an issue in the setting. The adjusted R-squared of the model is 0.39.

4.5 Endogeneity issues

In Sections 4.2 and 4.3 I find a positive correlation between profit sharing and corporate innovation, and a negative correlation between health and safety concerns and corporate innovation. However, the results are possibly subject to two types of endogeneity: omitted variables and reverse causality. In both cases, the coefficient estimates from the OLS regressions would be biased and inconsistent. The possibility of endogeneity issues should be considered when interpreting my results.

The omitted variable problem arises, if the models omit any variables that affect both profit sharing or health and safety concerns and corporate innovation. Despite the relatively large number of control variables in my regressions, there can still be a number of such variables. Some examples from prior innovation literature are firm growth, capital structure, firm age, corporate governance and stock return volatility. Also geographic clustering may matter as for example Audretsch and Feldman (1996) report that high-tech firms located in urban areas are more innovative than firms located in rural areas. All omitted variables are not easy to control for, as factors like supportive management and work atmosphere could be significant factors on innovation, the use of profit sharing and health and safety concerns.

The other possible problem is reverse causality running from corporate innovation to profit sharing. While my results suggest that profit sharing spurs innovation, in reality the relation could be bidirectional, meaning that innovative firms tend to grant profit sharing programs. Aets et al. (2015) point out that firms with a profit sharing program probably attract performance oriented and cooperative workers, who presumably are more innovative. Ittner et al. (2003) argue that firms may use stock options to reward employees for their superior performance in past innovation activities. It could be easily alleged that the theory holds also for profit sharing, and that the purpose of profit sharing is to reward past activities rather than to foster future innovation. However, the two directions of causality are not mutually exclusive and may be at work simultaneously, meaning that despite the rewarding purpose profit sharing also incites future innovation.

Reverse causality may also occur between corporate innovation and health and safety concerns. This would imply that firms that are more innovative tend to channel more resources in employees’ health and safety, so that issues covered in the variable do not occur. For example, Hong et al. (2012) find that financially constrained firms are less likely to spend resources on CSR. Financially constrained firms, in turn, are less likely to innovate (Savignac, 2008). In addition, health and safety concerns might suffer from measurement error because they are difficult to quantify given the qualitative nature of the concerns covered, as is the case in many

CSR-relates issues (Krüger 2015). In my sample also the small amount of firms facing health and safety concerns may lead to biased results.

One way to address the endogeneity issues would be to identify and control for all the variables that have an influence on both corporate innovation and profit sharing or health and safety concerns. Of course, it is not plausible to get rid of all endogeneity this way, because there are countless factors that could affect both the dependent and independent variables. To mitigate any remaining endogeneity, it is common practice to use the instrumental variable approach. In my regressions, this instrumental variable should be correlated with health and safety concerns or the use of profit sharing programs but be unrelated to corporate innovation. Finding such instruments is however hard and time-consuming, and I leave the instrumental variable approach as something to be considered in future research.

5 Further analysis

I conduct some further analysis to better understand the channels through which profit sharing and health and safety affect corporate innovation. First I study in more detail firms that use a profit sharing scheme in some, but not in all, years. Then I follow Chang et al. (2015) and divide the sample in two ways to find out whether my results vary in different firms. Firstly, I examine if the effects of profit sharing and health and safety concerns on innovation are stronger in those firms, where the input of non-executive employees is more pronounced. Secondly, I estimate the impact of free-riding among employees.

5.1 Firms with changing status of profit sharing

I am interested to examine how, at firm-level, the taking into or out of use of profit sharing affects corporate innovation. Thus I conduct a subsample that includes all those firms that face a change in the value of profit sharing (dummy variable, 1 or 0). That is, the firm might not use profit sharing in earlier years but takes it into use later, or vice versa. The status of the use of profit sharing may also change back, for example if a firm first uses profit sharing, then stops using it, and then starts using it again. The subsample involves 58 firms and 412 firm-years.

Conducting a corresponding subsample with health and safety concerns ends up with only 26 firms, making similar analysis impractical.

Since the argument throughout this paper has been that profit sharing enhances innovation, I expect that the innovation outcome is higher for the subsample firms in those years, when profit sharing has been in use. As profit sharing is expected to be a valid incentive for corporate innovation, it should be that a firm has more innovation activity when it has a profit sharing program than when it has not. In this analysis the timing of innovation is crucial as the use of profit sharing is year-specific, and my choosing of measuring the number of patents and citations at years t+1 and t+2 can be criticised.

I have calculated two means of the innovation measures (number of patents and citations, and them scaled with R&D expenses) for each firm in the subsample: means when profit sharing is in use, and means when profit sharing is not in use. Table 6 shows the means of all firm means, resulting in single values for all innovation measures when the profit sharing dummy is 1 and when it is 0. Unexpectedly, the number of patents is slightly larger and the number of citations is notably larger in those years when the firms do not have profit sharing. The relations are the same when patents and citations are scaled with R&D expenses. These results imply that in firms where the use of profit sharing has changed, innovation activity has been higher when there has not been a profit sharing program. However, after conducting the two independent samples t-test (Welch's t-test), it appears that the difference between the means is statistically significant only for Citations/R&D, with a p-value of 0.09. I conclude that there are no significant differences between the groups, meaning that a firm’s decision to implement a profit sharing scheme does not necessarily lead to enhanced innovation activity.

The results can be affected from wrong timing of patents in my data, as I use patents that are applied for in years t+1 and t+2, when in reality the innovation process can be much longer than two years. Deciding the accurate time period to use in the regressions is difficult, since some patents may need years of work before they can be applied for, and some patents are contrived in just one year. To the best of my knowledge, there is no study of the average time of the innovation process. In previous innovation studies, the timing varies, and there is no general practice of in what years patents and citations should be measured. For example, Blanco and Wehrheim (2017) use year t, Chang et al. (2015) use year t+1 and He and Tian (2013) use year t+3 in their regressions.

Table 6: Means of changing value of profit sharing

The sample consists of 58 firms and 412 firm-years jointly covered in the MSCI Database, Compustat and the NBER Patent and Citation Database between 1995 and 2003. *Profit sharing* tells if a given firm has a profit sharing program or not (dummy variable). All the firms in the sample have experienced a change in the variable, so that in some year(s) the dummy variable has been 1, and in some year(s) 0. First is calculated separately for each firm the means of the innovation measures when *Profit sharing* is 0 and when it is 1. This table reports the means of the means when *Profit sharing* is 0 and when it is 1. *Patents* is the sum of the number of patents in years t+1 and t+2. *Citations* is the sum of the number of patent citations in years t+1 and t+2, which is adjusted using the weighting index of Hall et al. (2005). *Patents/R&D (Citations/R&D)* is the firm's number of patents (citations) in years t+1 and t+2 scaled by R&D expenses in millions in year t.

Profit Sharing	Patents	Citations	Patents/R&D	Citations/R&D
0	431.90	8486.69	0.92	14.19
1	340.51	3800.83	0.76	7.96

5.2 Importance of employees' input in terms of innovation

Skills and efforts of employees are essential factors of the innovation process, and Galia and Legros (2004) argue than one of the most important barriers to innovation is the lack of skilled personnel. I expect that the impacts of profit sharing and health and safety concerns on corporate innovation are more pronounced in firms, where the input of non-executive employees is relatively more important. I follow Chang et al. (2015) and use R&D expenses scaled by employees as a proxy for employee importance. Ouimet and Zarutskie (2014) state that labour and human capital play increasingly important roles in production, especially in R&D-intensive industries. Therefore per-employee R&D expenses should correlate highly with employee importance in innovation. Table 6 reports the mean, median and standard deviation of the new variable R&D expenses/1,000 employees in columns 1-3, respectively. An average firm in the sample uses 23.7 million R&D expenses per 1,000 employees, while the median is smaller at 8.9 million.

Table 7: Summary statistics for employee importance

The sample consists of 2,686 firm-years jointly covered in the MSCI Database, Compustat and the NBER Patent and Citation Database between 1995 and 2003. *R&D expenses/1,000 employees* is the firm's R&D expenses in millions scaled by employees in thousands in year t.

	Whole sample		
		n = 2,686	
	Mean	Median	Std. Dev.
	(1)	(2)	(3)
R&D expenses/1,000 employees	23.70	8.88	40.66

I use the new variable R&D expenses/1,000 employees to sort the sample into two subsamples: firms with R&D expenses scaled by employees in thousands above (below) the sample median to represent firms with high (low) employee importance. I then re-estimate equations (1) and (2) separately for the two groups.

The results, reported in Table 8, show that the coefficients of profit sharing are highly positive and significant for firms with higher R&D per employee, while the coefficients are not significantly different from zero among firms with lower R&D per employee. The results indicate that the effect of profit sharing on innovation is indeed stronger in firms where employee inputs are more valued. For health and safety concerns, the coefficients are highly negative and significant only for firms with higher R&D per employee, while the coefficients are not significantly different from zero among firms with lower R&D per employee. This implies that the negative effect of health and safety concerns exists stronger in firms where employee inputs are more valued.

Table 8: Differences of the effects of profit sharing and health and safety concerns on innovation based on employee importance

The sample consists of 2,686 firm-years jointly covered in the MSCI Database, Compustat and the NBER Patent and Citation Database between 1995 and 2003. This table portions the sample into two subsamples based on employee importance, which is measured by *R&D expenses/1,000 employees.* Firms with R&D expenses per 1,000 employees below (above) the sample median are classified as having low (high) employee importance. *Patents* is the sum of patents in years t+1 and t+2. *Citations* is the sum of patent citations in years t+1 and t+2, which is adjusted using the weighting index of Hall et al. (2005). *Patents/R&D (Citations/R&D)* is the firm's number of patents (citations) in years t+1 and t+2 scaled by R&D expenses in year t. *Profit sharing* tells if a given firm has a profit sharing program or not (dummy variable). *Health and Safety Concerns* tells if a given firm has experienced issues with health and safety (dummy variable). All regressions in this table include constant terms and the control variables used in Table 2, but the coefficients are not reported due to irrelevancy. N_{low} is 1,344 and N_{high} is 1,342. In parentheses are the t-statistics, which are calculated using robust standard errors. The symbols ***, **, * and . denote significance at the 0.1%, 1%, 5% and 10% levels, respectively.

	Ln(1+patents)		Ln(1+citations)	
	Low	High	Low	High
Profit sharing	-0.096	0.525***	-0.048	0.543***
	(-0.81)	(5.68)	(-0.28)	(4.26)
Health and Safety Concerns	-0.172	-1.226***	-0.255	-1.313***
	(-1.01)	(-4.10)	(-1.10)	(-3.82)
	Ln(1+Patents/R&D)		Ln(1+Citations/R&D)	
	Low	High	Low	High
Profit sharing	-0.002	0.138***	0.054	0.281***
	(-0.05)	(6.32)	(0.72)	(5.07)
Health and Safety Concerns	0.002	-0.152***	-0.075	-0.502***
	(0.05)	(-4.05)	(-0.76)	(-4.04)

To test if the differences between the two groups (low and high employee importance) are statistically significant, I conduct additional regressions with interaction terms. I first generate a new dummy variable, which gets value 1 if the firm has high employee importance (R&D expenses per 1,000 employees is more than the median value 8.88), and value 0 if the firm has low employee importance (R&D expenses per 1,000 employees is less than 8.88). Then I create two interaction terms by multiplying the new dummy variable with the profit sharing and health and safety concern variables. The three new variables (dummy, dummy*profit sharing and dummy*health and safety concerns) are added to the baseline models (1) and (2). Now the interaction terms reveal whether there are true differences between the groups or not. The regression results in Table 9 show that coefficients of the interaction terms for both profit sharing and health and safety concerns are significant at least at the 1% level for all innovation measures, meaning that the differences found in Table 8 are significant.

Table 9: Significance of the differences of the effect of profit sharing and health and safety concerns on innovation between groups based on employee importance

The sample consists of 2,686 firm-years jointly covered in the MSCI Database, Compustat and the NBER Patent and Citation Database between 1995 and 2003. *Dummy* is 1 (0) if the firm's employee importance is high (low), meaning that *R&D expenses/1,000 employees* is above (below) the sample median. *Profit Sharing* tells if a given firm has a profit sharing program or not (dummy variable). *Health and Safety Concerns* tells if a given firm has experienced issues with health and safety (dummy variable). *Dummy* is multiplied with *Profit Sharing* and *Health and Safety Concerns* to conduct interaction terms: *Profit Sharing*Dummy* and *Health and Safety Concerns*Dummy*. The significances of the interaction terms indicate the significance of differences between the groups based on employee importance. *Patents* is the sum of patents in years t+1 and t+2. *Citations* is the sum of patent citations in years t+1 and t+2, which is adjusted using the weighting index of Hall et al. (2005). *Patents/R&D (Citations/R&D)* is the firm's number of patents (citations) in years t+1 and t+2 scaled by R&D expenses in year t. All regressions in this table include constant terms and variables used in Table 2, but the coefficients are not reported due to irrelevancy. In parentheses are the t-statistics, which are calculated using robust standard errors. The symbols ***, **, * and . denote significance at the 0.1%, 1%, 5% and 10% levels, respectively.

	Ln(1+patents) OLS	Ln(1+citations) OLS	Ln(1+Patents/R&D) OLS	Ln(1+Citations/R&D) OLS
Dummy	0.529***	0.768***	-0.080***	-0.041
	(5.35)	(5.50)	(-3.85)	(-0.73)
Health and Safety Concerns * Dummy	-1.112***	-1.077**	-0.203***	-0.537***
	(-3.39)	(-2.76)	(-3.88)	(-3.54)
Profit Sharing * Dummy	0.764***	0.765***	0.160***	0.267**
	(4.90)	(3.54)	(4.11)	(2.86)

5.3 Employee free-riding

Since profit sharing for non-executive employees reward them for joint performance improvements, free-riding caused by an individual employee's incapability to affect the profit to be shared may hamper the positive incentive effect. Innovation results usually from teamwork, and with teamwork comes free-riding. Hochberg and Lindsey (2010) find that the power of the incentive effect of stock options can be diluted, if free-riding problems are severe among non-executive employees. I expect that also the impact of profit sharing on corporate innovation is more pronounced in firms, where the free-riding problems are less present. Hochberg and Lindsey (2010) point out that employees share the rewards with fewer colleagues in firms with fewer employees, which leads to reduction of the free-riding problem. Following

Chang et al. (2015), I use the number of employees as a proxy for the extent of free-riding. As reported in Table 1, the mean for the number of employees in the sample firms is 28,000 employees and the median is 10,000 employees, making the firms in the sample relatively big.

I also test how the effect of health and safety concerns changes between firms with different amounts of employees. I expect that in firms with less employees (less free-riding), the effect of these problems on corporate innovation is more severe. My argument is that in smaller work communities, the existence of health and safety concerns have a larger impact on individuals, since the issues come closer than in large communities. In firms with more employees, problems with health and safety might affect only a small part of the community, while the other employees do not feel concerned.

I sort the sample into two subsamples based on the number of employees: firms with employees above (below) the sample median to represent firms with high (low) free-riding problems. I then re-estimate equations (1) and (2) separately for the two groups. The results are reported in Table 10. Additionally, I run regressions with interaction terms to find if the differences between the groups are statistically significant. I generate the two interaction terms by multiplying profit sharing and health and safety concern variables with a new dummy variable. The dummy variable gets value 1 if the firm has high employee free-riding (the number of employees is more than the median value 10,140), and value 0 if the firm has low employee free-riding (the number of employees is less than 10,140). The three new variables (dummy, dummy*profit sharing and dummy*health and safety concerns) are added to the baseline models (1) and (2). The regression results are reported in Table 11.

In Table 10, the results for profit sharing show that the differences between the groups are as expected, but quite small. When using patents and citations as innovation measures, the coefficients of profit sharing are positive and significant for firms with less employees, and firms with more employees have slightly smaller coefficients. For patents/R&D and citations/R&D, the differences between the groups are very small. Nevertheless, Table 11 reveals that the differences are not significant for any of the innovation measures, as the interaction term gets very small t-values in all regressions.

The results for health and safety concerns in Table 10 are against my expectations. When corporate innovation is measured by patents and citations, the coefficients show a larger negative effect of health and safety concerns on innovation for firms with more employees, while the effect is not even significant for firms with less employees. For patents/R&D and citations/R&D, the coefficients are more negative for firms with less employees, but the results are significant only for citations/R&D, and only at the 10% level. The small sample makes testing the differences between firms with different number of employees difficult. In fact, only 12 firm observations among the firms with less employees are identified to have health and safety concerns. Table 11 confirms that there is no statistically significant difference between firms portioned by the number of employees, since the coefficients of the interaction term are not significant. I conclude that due to the small number of firms with health and safety concerns in my sample, testing the differences between these groups is ineffective.

Because the two separate groups had small but non-significant differences in coefficients for profit sharing, I am interested to see how the results turn out with a more radical sorting. I thus sort the sample again by the number of employees: firms with employees below the lower quartile (3,300) to represent firms with low free-riding problems, and firms with employees above the upper quartile (29,200) to represent firms with high free-riding problems. This sorting cannot be done for health and safety concerns, since the number of firms with these issues is so small. The results, tabulated in Table 12, show even smaller differences between coefficients compared to Table 10. The results in Tables 10-12 conclude that, if the number of employees is a valid proxy for free-riding, I do not find evidence that the impact of profit sharing on innovation is more pronounced in firms with less free-riding. The results can be affected by the fact that all the firms in my sample are relatively big, possibly making the sorting by the number of employees ineffective.

Table 10: Differences of the effects of profit sharing and health and safety concerns on innovation based on employee free-riding

The sample consists of 2,686 firm-years jointly covered in the MSCI Database, Compustat and the NBER Patent and Citation Database between 1995 and 2003. This table portions the sample into two subsamples based on employee free-riding, which is measured by *Number of employees.* Firms with the number of employees below (above) the sample median are classified as having low (high) free-riding among employees. *Patents* is the sum of patents in years t+1 and t+2. *Citations* is the sum of patent citations in years t+1 and t+2, which is adjusted using the weighting index of Hall et al. (2005). *Patents/R&D (Citations/R&D)* is the firm's number of patents (citations) in years t+1 and t+2 scaled by R&D expenses in year t. *Profit sharing* tells if a given firm has a profit sharing program or not (dummy variable). *Health and Safety Concerns* tells if a given firm has experienced issues with health and safety (dummy variable). All regressions in this table include constant terms and the control variables used in Table 2, but the coefficients are not reported due to irrelevancy. N_{low} is 1,343 and N_{high} is 1,343. In parentheses are the t-statistics, which are calculated using robust standard errors. The symbols ***, **, * and . denote significance at the 0.1%, 1%, 5% and 10% levels, respectively.

	Ln(1+patents)		Ln(1+citations)	
	Low	High	Low	High
Profit Sharing	0.541***	0.320**	0.663***	0.386**
	(5.39)	(3.03)	(4.32)	(2.72)
Health and Safety Concerns	-0.158	-0.637***	-0.297	-0.728***
	(-0.40)	(-3.82)	(-0.52)	(-3.61)
	Ln(1+Patents/R&D)		Ln(1+Citations/R&D)	
	Low	High	Low	High
Profit Sharing	0.078**	0.095***	0.230**	0.213***
	(2.88)	(3.70)	(3.29)	(3.56)
Health and Safety Concerns	-0.115	-0.052	-0.420*	-0.213*
	(-1.50)	(-1.50)	(-1.97)	(-2.35)

Table 11: Significance of the differences of the effect of profit sharing and health and safety concerns on innovation between groups based on employee free-riding

The sample consists of 2,686 firm-years jointly covered in the MSCI Database, Compustat and the NBER Patent and Citation Database between 1995 and 2003. *Dummy* is 1 (0) if the firm's employee free-riding is high (low), meaning that the *Number of employees* is above (below) the sample median. *Profit Sharing* tells if a given firm has a profit sharing program or not (dummy variable). *Health and Safety Concerns* tells if a given firm has experienced issues with health and safety (dummy variable). *Dummy* is multiplied with *Profit Sharing* and *Health and Safety Concerns* to conduct interaction terms: *Profit Sharing*Dummy* and *Health and Safety Concerns*Dummy.* The significances of the interaction terms indicate the significance of differences between the groups based on employee free-riding. *Patents* is the sum of patents in years t+1 and t+2. *Citations* is the sum of patent citations in years t+1 and t+2, which is adjusted using the weighting index of Hall et al. (2005). *Patents/R&D (Citations/R&D)* is the firm's number of patents (citations) in years t+1 and t+2 scaled by R&D expenses in year t. All regressions in this table include constant terms and variables used in Table 2, but the coefficients are not reported due to irrelevancy. In parentheses are the t-statistics, which are calculated using robust standard errors. The symbols ***, **, * and . denote significance at the 0.1%, 1%, 5% and 10% levels, respectively.

	Ln(1+patents)	Ln(1+citations)	Ln(1+Patents/R&D)	Ln(1+Citations/R&D)
	OLS	OLS	OLS	OLS
Dummy	0.420***	0.479**	0.083**	0.150*
	(4.06)	(3.27)	(-3.27)	(2.36)

Health and Safety Concerns * Dummy	-0.362	-0.376	0.020	0.045
	(-0.85)	(-0.63)	(0.24)	(0.21)
Profit Sharing * Dummy	0.114	0.166	0.044	0.082
	(0.80)	(0.84)	(1.31)	(0.89)

Table 12: Differences of the effect of profit sharing on innovation and health and safety concerns based on employee free-riding, portioning by the lower and upper quartile

The description in the legend of Table 10 holds in this table, except for the sample size (now 1,343) and the dividing of the two subsamples. Here firms with the number of employees below the lower quartile (3,300) are classified as having low free-riding among employees. Similarly, firms with the number of employees above the upper quartile (29,200) are classified as having high free-riding among employees. N_{low} is 672 and N_{high} is 671. In parentheses are the t-statistics, which are calculated using the Huber-White heteroscedasticity consistent standard errors. The symbols ***, **, * and . denote significance at the 0.1%, 1%, 5% and 10% levels, respectively.

	Ln(1+patents)		Ln(1+citations)	
	Low	High	Low	High
Profit Sharing	0.457**	0.364**	0.662**	0.527**
	(3.24)	(2.71)	(2.91)	(2.87)
Health and Safety Concerns	-0.521	-0.588**	-0.531	-0.628*
	(-1.63)	(-2.83)	(-1.11)	(-2.50)
	Ln(1+Patents/R&D)		Ln(1+Citations/R&D)	
	Low	High	Low	High
Profit Sharing	0.077*	0.095***	0.276**	0.278***
	(2.15)	(3.73)	(2.74)	(3.91)
Health and Safety Concerns	-0.065	-0.075*	-0.186	-0.249*
	(-1.35)	(-2.47)	(-1.03)	(-2.56)

6 Conclusion

Innovation has become a key strategy to enhance firm growth in the current millennium. Thus employing an effective incentive scheme to spur corporate innovation has become one of the greatest concerns in companies. While most of the previous literature on the factors that incite innovation has considered executive and financial incentives, this novel study contributes to the literature of non-executive and non-financial incentives. In this thesis, I have studied the effect of cash profit sharing programs and health and safety concerns on corporate innovation, using a sample of U.S. firms jointly covered in the NBER Patent and Citation Database, MSCI ESG KLD STATS database and Compustat between 1995 and 2003. The final sample consisted of 2,686 firm-years. I captured the use of profit sharing and the problems with health and safety with dummy variables. Corporate innovation was measured with patents, citations, and them scaled with R&D expenses. I also introduced a number of control variables, including firm size, executive compensation and capital expenditures.

I compared the sample firms by dividing them into two subsamples, and documented a clear difference in innovativeness between companies with and without a profit sharing program. For health and safe concerns, the differences were not as pronounced between the two subsamples. I then run OLS regressions, and found a positive and significant effect of profit sharing on corporate innovation. I also showed a negative and significant effect of health and safety concerns on corporate innovation. The results were robust to the use of negative binomial regressions, but not to the use of R&D expenses as innovation measure. With further analysis I found that the positive effect of profit sharing programs and the negative effect of health and safety concerns on innovation are more pronounced in firms where employees' input to innovation is more important. However, inconsistent with Chang et. al (2015), I concluded that in firms with a less severe free-riding problem among employees the effects of profit sharing and health and safety concerns on corporate innovation are not more prevalent. I also tested how profit sharing affects innovation in firms where the use of profit sharing programs has changed, and did not find that the firms would have had more innovation activity in those years when profit sharing was in use.

Kruse (1996) states that one of the main reasons why companies would implement profit sharing is to boost workplace productivity and co-operation. Asongu (2007) acknowledges that in addition to profitability, CSR creates opportunities for enhanced corporate innovation. My regression results establish concrete proof for these arguments. The results suggest that profit sharing adds to companies' innovative capacity, which should encourage more firms to adapt profit sharing as a rewarding system to their employees. My results for health and safety concerns imply that to improve innovation, a firm should use resources to enhance CSR so that severe problems with health and safety can be avoided. My findings also emphasize the role of non-executive employees as important innovators in firms, and thus enrich the stakeholder theory of corporate finance.

My results may be exposed to endogeneity issues which could lead the results to be biased and inconsistent. The two types of possible endogeneity concerns are omitted variables and reverse causality. Addressing these issues by obtaining more control variables and using the instrumental variable approach would be a sufficient topic for further research. Also, as my results are based on data from the U.S., it could be interesting to examine if the results hold in other countries.

The theme of valid incentives to spur corporate innovation still has a lot of issues to be examined. Rudis reported already in 2004 that one of the main concerns of CEOs is how to stimulate innovation and creativity among employees. It is plausible that the question raises even more interest in the coming years, as the importance of innovation gets increasing attention. For example, the massive coming of start-up companies has also made the traditional firms to realise that innovation is crucial to keep up with competitors. Especially the role of non-executive employees as company innovators is still an underexplored topic, and leaves many suggestions for future research. The same holds for non-monetary incentives, which I believe have a significant impact on non-routine work like innovation. What is the role of for example work atmosphere, supportive management and flexible work schedules? It could easily be argued that employees who enjoy their work place are also more active in pursuing innovation.

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